

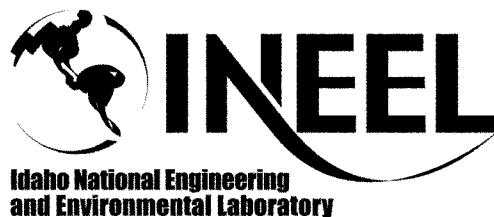
#### **7.8.4 Fissile Material Disposition**

# Engineering Design File

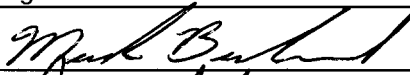

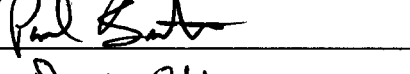
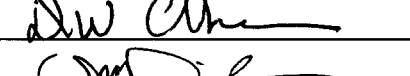
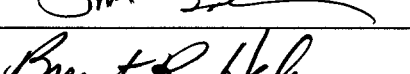
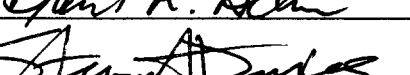
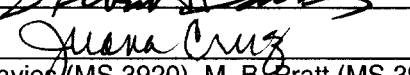
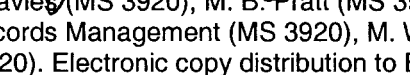
PROJECT FILE NO. 021052

## Disposition of Fissile-Monitored Material for the OU 7-10 Glovebox Excavator Method Project

Prepared for:  
U.S. Department of Energy  
Idaho Operations Office  
Idaho Falls, Idaho



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2. Project File No.: 021052				
3. Index Codes: Building/Type WMF-671 SSC ID N/A Site Area 098				
4. Summary:  The purpose of this Engineering Design File (EDF) is to provide a basis for operational decisions and procedures involving monitoring material suspected of containing concentrations of fissile material and packaging of monitored materials. <i>Estimated OU 7-10 Target Area Fissile Inventories Based on the Analysis of SWEPP Radioassay Data</i> (EDF-1972) evaluated Stored Waste Examination Pilot Plant (SWEPP) assay results from wastes types similar to those buried in Operable Unit (OU) 7-10, to determine the probability of a drum exceeding the administrative limit of 200 fissile gram equivalent (FGE). While it does identify fissile material loading probabilities, EDF-1972 does not provide direction on how to disposition material that has been monitored (i.e., whether to co-package monitored and non-monitored materials).  To ensure a conservative margin in not exceeding 200 FGE per drum, four administrative controls are established in this EDF. The fissile content values identified in the bounding conditions include the uncertainties associated with the measured value. The four bounding conditions for disposition of fissile material are described below:  <ul style="list-style-type: none"> <li>• If measured material from one cartload exceeds 50 FGE content and was commingled with waste, then the remainder of the cartload should also be measured</li> <li>• Up to 100 FGE of measured fissile material can be added to unmeasured material in the same drum</li> <li>• For conditions where measured material exceeds 100 FGE but is less than 200 FGE, the material can be subdivided to less than 100 FGE and disposed of with unmeasured material or the material may be packaged in a separate drum without unmeasured material</li> <li>• For conditions where measured material exceeds 200 FGE, the material must be subdivided until it can meet one of the previous cases.</li> </ul>				
5. Review (R) and Approval (A) and Acceptance (Ac) Signatures: (See instructions for definitions of terms and significance of signatures.)				
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# Disposition of Fissile-Monitored Material for the OU 7-10 Glovebox Excavator Method Project

## 1. INTRODUCTION

The purpose of this Engineering Design File (EDF) is to provide a basis for operational decisions and procedures involving monitoring material suspected of containing concentrations of fissile material and packaging of those monitored materials. *Estimated OU 7-10 Target Area Fissile Inventories Based on the Analysis of SWEPP Radioassay Data*<sup>1</sup> evaluated Stored Waste Examination Pilot Plant (SWEPP) assay results from wastes types similar to those buried in Operable Unit (OU) 7-10, to determine the probability of a drum exceeding the administrative limit of 200 fissile gram equivalent (FGE). While it does identify fissile material loading probabilities, EDF-1972 does not provide direction on how to disposition material that has been monitored (i.e., whether to co-package monitored and non-monitored materials).

## 2. BACKGROUND

The project storage requirement requires that each drum contain less than 200 g of fissile material. The conservative approach to ensure that no drums are packaged exceeding the 200-g limit is to measure fissile content of all materials in real time during drum loading. This approach was implemented in the previous Stage II design. However, to increase the production rate and reduce project cost, the baseline design as presented in the *Waste Area Group 7 Analysis of OU 7-10 Stage II Modifications*<sup>2</sup> deleted monitoring all material during packaging for fissile content except waste visually containing graphite. The approach was further expanded in the *OU 7-10 Glovebox Excavator Method Project Conceptual Design Report for Critical Decision 1*<sup>3</sup> to include segregating unidentifiable combustible material (i.e., any material suspect of containing filter media would be monitored prior to packaging).

Following conceptual design, the project has had numerous meetings to determine how to comply with the 200-g/drum limit including:

- March 15, 2002—A position was established that 200 g/drum is an administrative limit, not a Technical Safety Requirement or safety-related limit. It is the responsibility of operations, process, or project management personnel to determine the assumptions and operating method to meet the 200-g/drum fissile load limit, not that of safety, criticality controls, or the fissile material monitoring design personnel. (Personnel from safety analysis, criticality safety, and fissile monitor design provide input, review, and concur with these approaches as they are developed.)
- April 2, 2002—An agreement was reached among project representatives that adding counted fissile material to drums containing uncounted material was acceptable. Preliminary results of the SWEPP data indicated that adding up to 50 FGE of material counted by the monitor to uncounted material placed in a drum would not significantly increase the risk of overloading a drum beyond the 200-g/drum limit. The amount of counted fissile material that can be added to uncounted material would not be quantified until the SWEPP analysis EDF was finalized.

A proposal to address differences in package configuration between the SWEPP data and the planned project (two 2.5-ft<sup>3</sup> liners per drum) was rejected because drums will not be weighed during their loading. Therefore, presenting the data in terms of density rather than unit drums would not be useful.

- May 14, 2002—A request was made to evaluate the probabilities of drums exceeding 380 g/drum and 1,500 g/drum. The SWEPP assay data are not well represented by either a normal or log-normal distribution, so a non-parametric analysis technique is being used to evaluate the data. This approach cannot give valid estimates relative to 380 or 1,500 g/drum. Therefore, the project will space drums 16 in. apart prior to assay, consistent with *Criticality Safety Evaluation for Overloaded Drums at RWMC*.<sup>4</sup>

*Estimated OU 7-10 Target Area Fissile Inventories Based on the Analysis of SWEPP Radioassay Data*<sup>1</sup> evaluated SWEPP assay results from waste types similar to those buried in OU 7-10, to determine the probability of a drum exceeding the administrative limit of 200 FGE.<sup>1</sup> For anticipated waste materials, Blackwood, Akers, and May (2002) report that there is a 1.2% chance, with 95% confidence, that a drum would exceed 200 FGE. This means for the anticipated project estimate of 600 waste drums, that potentially seven drums could exceed the 200-FGE loading limit and would require repackaging. They also report that a hypothetical, intentional addition of 100 FGE to every drum only increases the probability of exceedance by 0.2% (i.e., raised to 1.4%). Therefore, if 100 FGE was added to each drum, the number of potentially overloaded drums increases from seven to eight drums. Excerpted from the report below is Table 3, which summarizes the probabilities.

Table 3. Estimated probabilities of exceeding 200 FGE for item description codes not to be measured by the fissile material monitor.

Item Description Code	Number of Drums in Pit 9 Target Area	Estimated Probability of Exceeding 200 FGE <sup>1</sup>					
		No Added FGE (%)	10 FGE Added (%)	25 FGE Added (%)	50 FGE Added (%)	75 FGE Added (%)	100 FGE Added (%)
001	3	0.1	0.1	0.1	0.1	0.2	0.3
002	27	12.3	12.3	12.3	12.3	12.3	12.3
003	379	2.2	2.2	2.2	2.2	2.2	2.2
004	2	6.1	6.1	8.5	13.6	15.9	22.7
005	42	0	0	0	0	0	0
330	260	1.0	1.0	1.0	1.5	1.5	1.5
480	28	1.6	1.6	1.6	1.9	1.9	2.6
Empty	544	0.2	0.2	0.2	0.2	0.2	0.2
Total <sup>2</sup>	1285	1.2	1.2	1.2	1.3	1.4	1.4

1. It should be noted that while the nominal confidence level for the item description code specific probability statements is at least 95%, the confidence in the Pit 9 excavation area total inventory probability values in the last row are reduced by an unknown amount by all of the approximations and assumptions that were made in relating the SWEPP results to the estimated Pit 9 inventory. This reduction in confidence could be considerable. A list of assumptions and caveats to applying the calculations to the Pit 9 inventory are given in the summary section (of Reference 1).

2. Weighted total probability based on distribution of waste in Column 2.

Graphite waste, although expected in the target area, was not included in the SWEPP data analysis of EDF-1972 because all identified graphite waste will be measured using the fissile material monitor (FMM). It should also be noted that while no filter material (i.e., IDC-376) is expected to be in the target area, any such material found during glovebox waste inspection will also be measured by the FMM. The

complete list of material that will be monitored for fissile content is provided in the *Criticality Safety Evaluation for the OU 7-10 Glovebox Excavator Method Project*.<sup>5</sup>

It is assumed that the drums buried in OU 7-10 have rusted and decayed to the point of disintegration. Waste contents of the drums, commingled with interstitial soil, will be excavated and packaged into 55-gal drums. Because the original waste drums are not intact, what might have been a drum load that exceeded 200 FGE could be subdivided during the excavation process, reducing the total load below the 200-FGE limit. On the other hand, with the drums no longer intact, waste from two different drums, neither of which exceeded the limit, could be combined during the excavation process, resulting in a combined load of greater than 200 FGE. In order to avoid this, an operational decision basis is needed to establish when fissile material can be or should not be added to a partially filled drum.

### 3. DISCUSSION

Note in the discussion below, that all values of fissile content include uncertainties. The technology of gamma spectroscopy has inherent systematic and random uncertainties associated with converting measured gamma spectra to fissile content. The FMMs used for this project add these uncertainties to the displayed value. For example, a system may detect a spectrum that equates to 70 FGE. However, the measurement may have uncertainties totaling 40%; therefore, the system would report a measured value of 98 FGE. Since the FMMs include uncertainties in their reported values, the FGE limits discussed below also include these uncertainties. Therefore, operators can directly compare values reported by the FMMs to the limits defined below.

Waste will be excavated and packaged into 55-gal drums. The waste will be loaded into the drums in a cart liner using a hoist. Each cart liner will contain approximately 2.5 ft<sup>3</sup> of waste, and each drum will hold two cart liners or 5 ft<sup>3</sup> of waste. As a cartload of waste is transferred into the glovebox, if there is no indication of materials identified as needing fissile monitoring (per suspect items described in the Criticality Safety Evaluation [CSE]), the waste will be packaged into a 55-gal drum without monitoring for fissile material. This approach assumes the 1.2% risk of creating an overloaded drum. After the drum has been filled, closed, and removed from the facility, it will be staged in lag-storage and then eventually assayed. If it is then identified as exceeding the 200-FGE limit, the drum will be returned, reopened, subdivided, and repackaged.

On the other hand, if any item is suspected of containing a significant quantity of fissile material (per the CSE), then the object will be segregated for fissile monitoring. Based on the above discussion of EDF-1972, the quantity of fissile material (as determined by the FMM) that can be added to a drum with uncounted material will be limited to 100 FGE. If an item or collection of material exceeds 100 FGE, the material must be subdivided and re-monitored for disposal. This approach implies that the uncounted material may contain up to 100 FGE per drum or 50 FGE per cartload. At this point, two questions must be evaluated:

1. Is the monitored material a discrete source (e.g., a bottle or graphite chunk) or was it commingled with the waste such that there is potentially an additional significant quantity of fissile material in the cartload?
2. If the material was commingled with waste, is there a potential that the cart load could exceed 100 FGE?

If the monitored item is discrete, then the item can be disposed of with any other waste form including soil, sludge, or debris. Additional monitored items may also be disposed of in the same drum as long as the sum of their fissile content remains less than 100 FGE.

On the other hand, if the material, containing significant quantity of fissile material, was commingled with waste such that the waste may also contain a significant quantity of fissile material, then additional monitoring of the waste is justified. If the monitored material from a single cartload totals more than 50 FGE, then for conservatism, the remaining cartload should also be monitored for fissile content. This can be accomplished by monitoring 1 ft<sup>3</sup> or smaller batches at a time for the cartload or by moving the fissile monitor shield wall out of the way and setting the entire cartload, contained in the liner, in front of the monitor. These scenarios and decision points are presented in a logic flowchart in Figure 1.

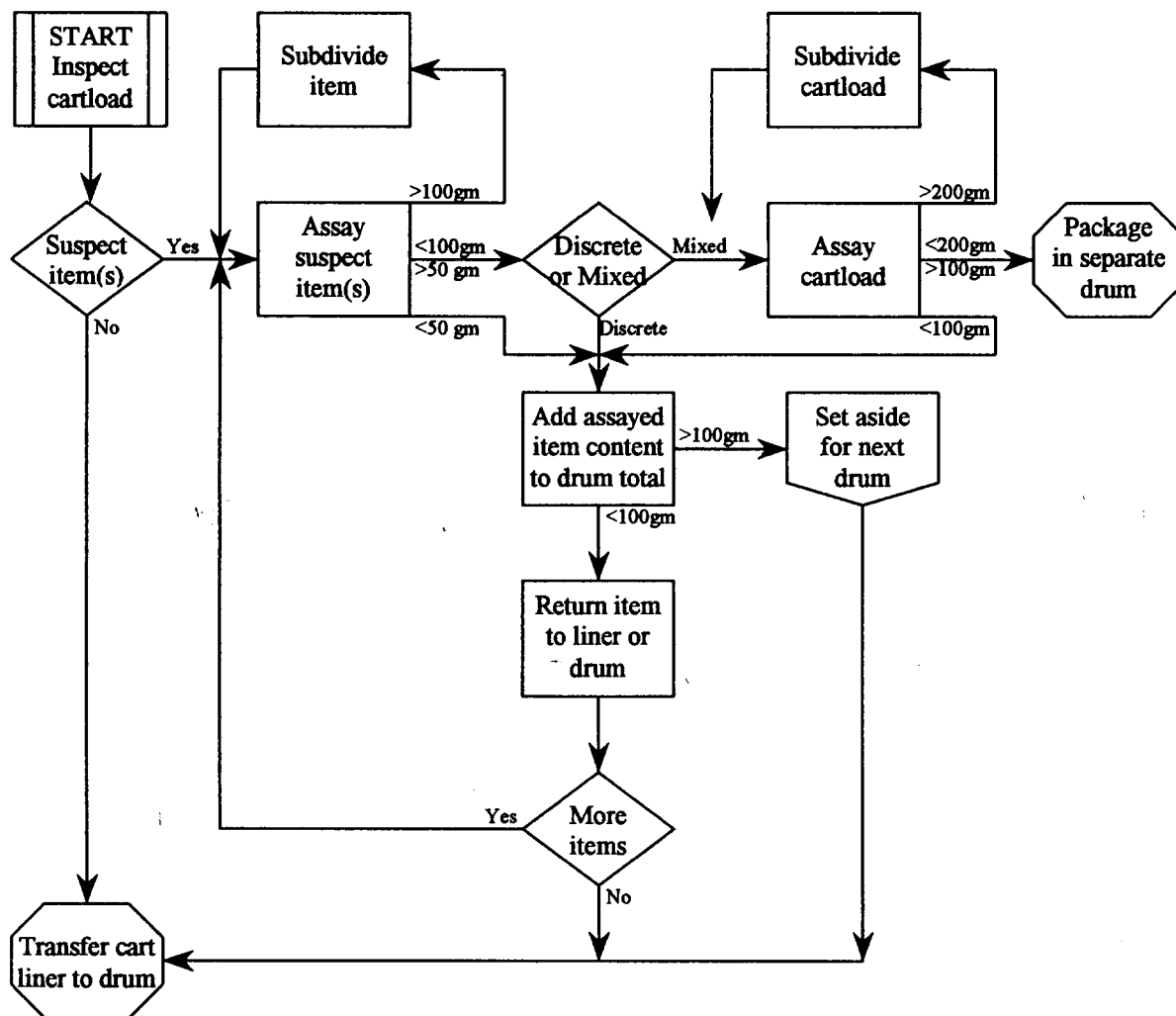


Figure 1. Decision flowchart for disposing of fissile-monitored material.

## 4. SUMMARY

The fissile content values identified in the bounding conditions include the uncertainties associated with the measured value. The four bounding conditions for disposition of fissile material are described below:

- If measured material (i.e., material required to be fissile monitored per the CSE) from one cartload exceeds 50 FGE content and was commingled with waste (i.e., material normally **not** required to be monitored), then the remainder of the cartload should also be measured
- Up to 100 FGE of measured fissile material (i.e., material required to be fissile monitored per the CSE) can be added to unmeasured material (i.e., material **not** required to be monitored) in the same drum
- For conditions where measured material exceeds 100 FGE but is less than 200 FGE, the material can be subdivided to less than 100 FGE and disposed of with unmeasured material (i.e., material **not** required to be monitored) or the material may be packaged in a separate drum without unmeasured material
- For conditions where measured material exceeds 200 FGE, the material must be subdivided until it can meet one of the previous cases.

## 5. REFERENCES

1. L. Blackwood, D. W. Akers, and D. May, *Estimated OU 7-10 Target Area Fissile Material Inventories Based on the Analysis of SWEPP Radioassay Data*, EDF-1972, Rev. 0, Idaho National Engineering and Environmental Laboratory, Bechtel BWXT Idaho, LLC, Idaho Falls, Idaho, June 2002.
2. INEEL, *Waste Area Group 7 Analysis of OU 7-10 Stage II Modifications*, INEEL/EXT-01-01105, Rev. 0, Idaho National Engineering and Environmental Laboratory, Bechtel BWXT Idaho, LLC, Idaho Falls, Idaho, October 2001.
3. INEEL, *OU 7-10 Glovebox Excavator Method Project Conceptual Design Report for Critical Decision 1*, INEEL/EXT-01-01512, Rev. 0, Idaho National Engineering and Environmental Laboratory, Bechtel BWXT Idaho, LLC, Idaho Falls, Idaho, January 2002.
4. INEEL, *Criticality Safety Evaluation for Overloaded Drums at RWMC*, INEEL/INT-97-00695, Rev. 1, Idaho National Engineering and Environmental Laboratory, Bechtel BWXT Idaho, LLC, Idaho Falls, Idaho, December 2001.
5. INEEL, "Criticality Safety Evaluation for the OU 7-10 Glovebox Excavator Method Project (Draft)," INEEL/INT-01-01617, Rev. 1A, Idaho National Engineering and Environmental Laboratory, Bechtel BWXT Idaho, LLC, Idaho Falls, Idaho, September 2002.